in July and average monthly min=15.3° C (59.6° F) in February (Fujioka and Haught, unpublished data)).

(3) Relative Humidity. Average relative humidity is about 70 to 80 percent in windward areas below the inversion level and less than 40 percent above.

(4) Wind. Prevailing winds over the island are generally from the northeast, but other winds, especially from the south through the west, are not uncommon. Localized patterns are quite variable, as influenced by Mauna Kea's mass and numerous prominent terrain features. The effect of topography can vary appreciably even with moderate deviation in wind velocity and direction, causing inconsistent wind behavior that is not readily predictable. Winds are generally out of the east in the mornings until orographic winds from the west overpower the trades in the early afternoon. This wind shift from easterly to westerly winds depends largely on the strength of the trades and the amount of cloud cover blocking radiative heating of the ground. During the transition period, winds are highly unpredictable in strength and direction. It is not uncommon for winds to shift 180 degrees over very short periods of time or distance. Average annual 20-ft wind speeds at Bradshaw Army Airfield from 1996 to 1998 were 10.7 mph (Fujioka and Haught, unpublished data) with very little variation from month to month (average monthly max=11.85 mph in December, average monthly min=9.72 mph in June). Constant vigilance to wind conditions is critical during fire protection.

e. Topography. PTA is in a "dry tropical upland (tropical sub-alpine dry land) biome unique to the Hawaiian Islands. The area is volcanic lava plateau, or plain, dotted with "puu" (cinder cones), and underlain by igneous beds. Slopes rise from the lava plateau between Mauna Kea to the north and Mauna Loa to the south of PTA. This plateau is referred to as the "saddle" area of the island. The elevation differences within PTA between lowest area of the plateau and the Mauna Kea slope range from 1,631m to 3,501m (4,030 to 8,650 ft).

7.6.2. Vegetation Fuels Classification.

The wildland fire fuel types found at PTA on the island of Hawaii are very different from those on Oahu. Plant Communities were mapped by Castillo *et. al.* (1997). These were grouped into six (6) classes to aid in mapping (Figure 12). These classes were derived from a set of fuel models described by Anderson (1982) representing fire behavior fuel models. Corresponding PTA Plant Community Types [PCT], per Castillo *et. al.* are shown in brackets.

a. Barren and Sparsely Vegetated Lands. [PCT 1, 2, 9, and 24].

(1) Lands dominated by barren lava or lava possessing a discontinuous and open vegetation structure. These lands comprise the majority of PTA. They do not have fuel loads sufficient to carry fire and are suitable to use as natural firebreaks.

(2) Fuel Model Correlate: None

b. Perennial Grassland. [PCT 22 and 23]

(1) Land dominated by perennial alien (*Pennisetum setaceum*) and native (predominately *Eragrostis atropioides*) grasses averaging about 1 meter in height. Found primarily on older substrates having relatively developed soils (~10,000 years old), however, some *P. setaceum* dominated lands are found on younger lava. These grasslands extend down slope from PTA on

7.6.3. Fire History for PTA.

a. Historically, fire in the area of PTA was most likely rare and of little significance, limited to volcanically started fires and occasional lightning ignitions. Military use for live-fire exercises and target practice has increased ignition frequency dramatically and resulted in numerous small fires, though it appears that much of the threat to endangered species populations is a result of off post ignitions.

b. Fire history at PTA was inferred as best as possible from existing fire records and documentation provided by various agency sources. Fire records were numerous for PTA but most were incomplete. Many records included a date, time, and location for each fire but very little information was available about the size of fires or the weather conditions during the fires. (See Analysis of Fire Management Concerns at PTA, Beavers and Burgan2000).

c. Fires caused by tracer ammunition is by far the largest cause of fires at PTA. This comes as no surprise since tracers easily start fires and are one of the most commonly used munitions. It is important to note that fires originating from non-military sources have caused the overwhelming majority of the acres burned at PTA. Since July 1990, over 3,237 hectares (8,000 acres) have been recorded as burned. Of these, over 3,116 hectares (7,700 acres) or 91% of all acres burned, were burned by fires caused by lightning, arson, or carelessly discarded cigarettes, and the largest of these started off of Army lands and later burned into PTA (Refer to Reference 7.6.1).

d. Based on fire history for PTA, the data show that the western and the northern sections of PTA potentially face the greatest threat of wildfire. Military training activities have been the leading cause of past fires. The high risks inherent in military training activities, the existence of heavy loads of readily ignitable fuel, and the prevalent dry conditions of the area present significant fire management problems for the training area and adjoining lands.